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ARCHEOLOGICAL IMPACTS OF PINYON-JUNIPER CHAINING: A TEST*

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Abstract

Clearing of pinyon-juniper forest and sage brushlands with caterpillar tractors and heavy drag chain is a common method of improving grassland grazing habitat in the western United States. A controlled chaining experiment on a surface lithic site in eastern Utah indicates that the soil disturbance produced by associated uprooting, dragging, and trampling actions can have serious effects on surface and subsurface archeological remains. These impacts can be quantified and discussed in terms of artifact displacement, loss, breakage, and churning. Some suggestions for mitigating these impacts are considered.

INTRODUCTION

The following are preliminary results of an experiment designed to assess the effects of mechanical tree and shrub removal from the surface of an archeological site (ML-1906) in east-central Utah. Additional evaluation of the site is anticipated for the 1974 field season. This type of tree removal, termed "chaining", is common throughout the western United States and is conducted with two large caterpillar tractors dragging a heavy anchor chain between them to uproot trees up to 2-feet in diameter. The ecological effects of opening the tree canopy are improved watershed, and increased wildlife and livestock grazing habitat due to development of a diversified and abundant grass community. The effects on local archeological resources, however, are not so beneficial. Consequently, this test

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was conducted to define and quantify the impacts to a typical surface lithic site within a chained pinyon-juniper forest, and secondly, to suggest ways of mitigating these impacts.

RESEARCH DESIGN

This test was designed to examine what were believed to be the three basic factors of chaining disruption: tree uprooting, chain travel, and location of the tractor paths. Related uprooting, dragging, and trampling impacts can be discussed in terms of artifact breakage, horizontal displacement, and subsurface churning. Undoubtedly, many other variables, such as temperature, ground slope, tree size, and density, soil type, and ground moisture may be critical locally but these factors were not considered in this preliminary examination.

Four 1-meter squares, each containing 32 evenly spaced, color-coded flake specimens, were established at select areas of the site. Each of these test squares was carefully located to receive a different impact according to the location of the drag chain, tractors, and possible tree uprooting effects. Accordingly, they were placed (a) in an open space between trees, (b) adjacent to a large pinyon tree, (c) in the tractor path, and (d) in a proposed turn-corner where the tractor would abruptly change direction by spinning sharply on one tread (see Fig. 13).

Two linear transects were established at either end of the site at approximately right angles to the direction of chaining. Flake specimens along these lines were color coded with a complete coat of spray paint and placed at measured (20cm) intervals.

All test specimens within the four squares and two linear transects were brightly painted and their locations recorded by transit and photograph to assist in recovery and evaluation of damage, displacement or loss after chaining. All other flake materials were cleared from the site surface so as not to be confused with new materials churned up during surface disruption.

RESULTS

After the test squares and transects were established and fully recorded, two D8-H caterpillar tractors dragging a 300-foot, 10 ton chain were directed onto the site. The following results were noted immediately after chaining and are undoubtedly affected by the presence of fresh dust and tree debris which obscured much of the site surface. The effects of weather and natural decay on these debris may expose many artifacts now concealed. Planned revisitation of the site in the future will seek to determine the extent and duration of this temporary screening effect.

Although it was not done at this locale, the normal practice of scraping together downed trees into windrows for burning would undoubtedly lead to considerably more disturbance of surface materials. The present results must therefore be viewed as a conservative estimate of the archeological impacts of chaining.

In terms of total artifact recovery, only 53% of the original 367 test square and transect specimens were relocated and only about one-third (124) were found undisturbed after chaining. The missing flakes were either trampled into the ground or else obscured by

churned soil, dust and fallen tree debris. Of the 135 specimens recovered from the two transects, 15 flakes exhibited an average displacement of 17.4cm. With one exception, all of this horizontal movement was with the direction of chain travel. However, this value should be viewed as a minimum because specimens transported greater distances were more likely to have been covered or buried in the process.

Each of the four test squares were affected differently due to chance and to their particular locations within the chaining area. The square placed in an opening between several trees in the chain path was missed entirely when the chain jumped this spot. The most affected square was one on which a tractor turned roughly grinding all but four (13%) of the flake specimens into the ground. Therefore, in decreasing order of artifact disruption the test square results are (in % missing flakes):

(d) tractor turn - 87%

(c) tractor path - 72%

(b) tree adjacent - 53%

(a) open clearing - 0% (missed entirely)

The greatest amount of artifact displacement along the transects was at the points where the one tractor crossed.

In terms of artifact damage, the tractor-turn and tractor-path squares show the only breakage noted at the site; this consisted of four flakes only.

During chaining, a total of 19 new flakes surfaced in the test area. Along with the number of specimens lost in the process, this

indicates that vertical movement of artifacts did take place. Another estimate of the extent of this subsurface disturbance is provided through examination of the size of tree root craters. A sample of 12 surface depressions caused by tree uprooting shows a mean diameter size of 1.7 meter and an average depth of 0.5 meter. The total surface area affected by this cratering was approximately 100 square meters; or in other words, 12% of the site surface was destroyed to a depth of about one-half meter. Additional damage due to dislodged roots, although less severe, is considerably more extensive than cratering, especially in dense stands such as this one. When they are less than 50 feet apart, extraction of the major root elements of pinyon and juniper trees will disturb all areas of the site to a depth of about 0.5-1.0 meter, and would be especially destructive at sites where chained trees are firmly anchored upon stone masonry features.

RECOMMENDATIONS FOR MITIGATING CHAINING IMPACTS

It is clear that measures must be taken to reduce or eliminate the disruptive effects of chaining on archeological sites. If chaining is unavoidable, one way of preventing uprooting damage would be to precut all trees on known sites by hand. This would eliminate all subsurface impacts but will not substantially reduce surface damage, and in areas of high site density (up to 54 sites per square mile on some parts of this Forest) these measures would be expensive and time consuming. Another method would be to carefully avoid site areas, thus providing "islands" of wildlife shelter, as well as site protection.

However, this may have the undesirable effect of advertising the site's presence to local relic collectors and would still require an intensive site survey and flagging program. Furthermore, some signal flags and site markers are easily missed (in the dust confusion of chaining).

Possibly the most effective and practical plan would be to conduct chaining activities during the winter months to take advantage of low temperatures and snow cover. This would reduce cratering and root dislodging effects because cold, brittle trees tend to snap rather than pull up, and snow depths of 1-2 feet will cushion surface materials. Thus, both surface and subsurface remains would probably receive less chaining impact, and this at no extra cost or effort to the chaining project. Winter chaining may be a more efficient method of tree removal as the kill rate of imcompletely chained trees may be enhanced by low temperature stress. It is also the only means of reducing archeological damage in areas which had not received prior archeological examination. A combination of winter chaining, selective hand cutting, and site avoidance procedures may be necessary depending on site size, concentrations, and surface or subsurface character.

SUMMARY AND CONCLUSIONS

Tree removal by chaining results in considerable surface and subsurface soil disturbance through uprooting, dragging, and trampling actions. In the present test, approximately one-half of the original surface artifacts were lost and two-thirds of the remainder were found to be disturbed after chaining. Horizontal displacement and surface artifact breakage was minimal, and the missing specimens were either trampled into the soil or else obscured by churned soil, dust, or fallen

tree debris. An estimated 12% of the site surface was totally destroyed by deep craters left by uprooted trees. In addition, the dislodging of extensive pinyon and juniper root systems is a serious threat to subsurface cultural materials to a depth of up to one meter throughout the entire chaining zone.

Although pinyon-juniper chaining on archeological sites is destructive to cultural artifacts, both above and below the ground surface, these impacts could be significantly reduced by selective avoidance, hand cutting, and/or cold weather chaining measures.

APPENDIX I
MISCELLANEOUS DATA

Site location: Moab District of the Manti-LaSal National Forest, San Juan County, east-central Utah.

Site Type: Surface scatter of flakes, plus a few biface blades and projectile points. Probably a hunting camp.

Site Elevation: 8,000 feet

Ground Cover: Approximate surface character: rocky-open soil, 10%; open soil, 40%; litter (mainly tree needles), 50%. No understory of brush or surface vegetation other than pinyon-juniper.

Slope of Site: 5-8% (4.5° to 7°)

Number of Test Specimens: 367 (squares, 128; transects, 239)

Number of Specimens Recovered: 195

Number of Specimens Lost: 172

Number of Specimens Surfaced: 19

Number of Specimens Undisturbed: 124

Number of Transect Specimens Displaced: 15

Average Distance Moved: 17.4cm

Root Crater Size (Sample of 12):
Depth - range, 30 - 70cm; mean, 50cm.
Diameter - range, 80 - 250cm; mean, 172cm.
Total surface coverage, 97 square meters.

Test Area Size: 827 square meters.

Number of Specimens Damaged: 4 (all in the two tracked squares)

Number of Trees: 42

Type of Trees: Doubleleaf pinyon (Pinus edulis) and Rocky Mountain Juniper (Juniperus scopulorum).

Fig. 1. Overview of the test area before chaining.

Fig. 2. Close-up of site before chaining.

Fig. 3. Overview of the test area after chaining. Note the size of figures in right distance for scale.

Fig. 4. Detail of the site surface debris after chaining.

Fig. 5. One of the two tractors used in the chaining. Tire over the tread is part of an automatic seeding device.

Fig. 6. A portion of the 300 foot, 10 ton chain used to uproot trees.

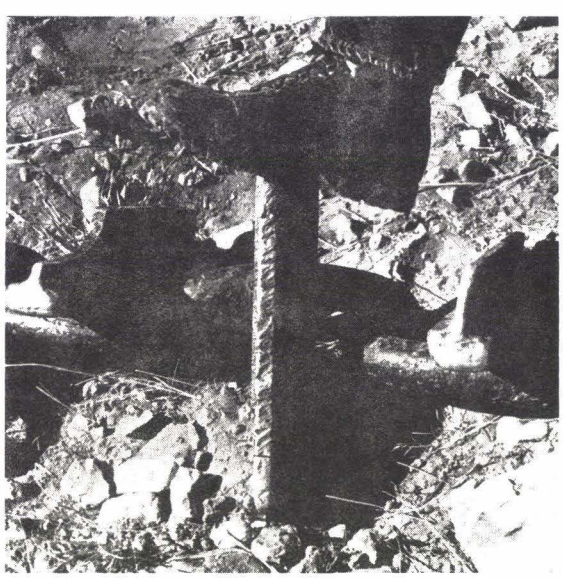

Fig. 7. Close-up of chain links showing welded cross piece which produces tilling effect on the soil.

Fig. 8. Laying out color-coded flakes on test square "B" before chaining.

Fig. 9. Uprooting sequence of a two ft. diameter Juniper showing initial contact of the chain traveling from left to right.

Fig. 10. Uprooting begins.

Fig. 11. Uprooting complete and the tree is displaced.

Fig. 12. Measuring the size of a crater produced by uprooting.

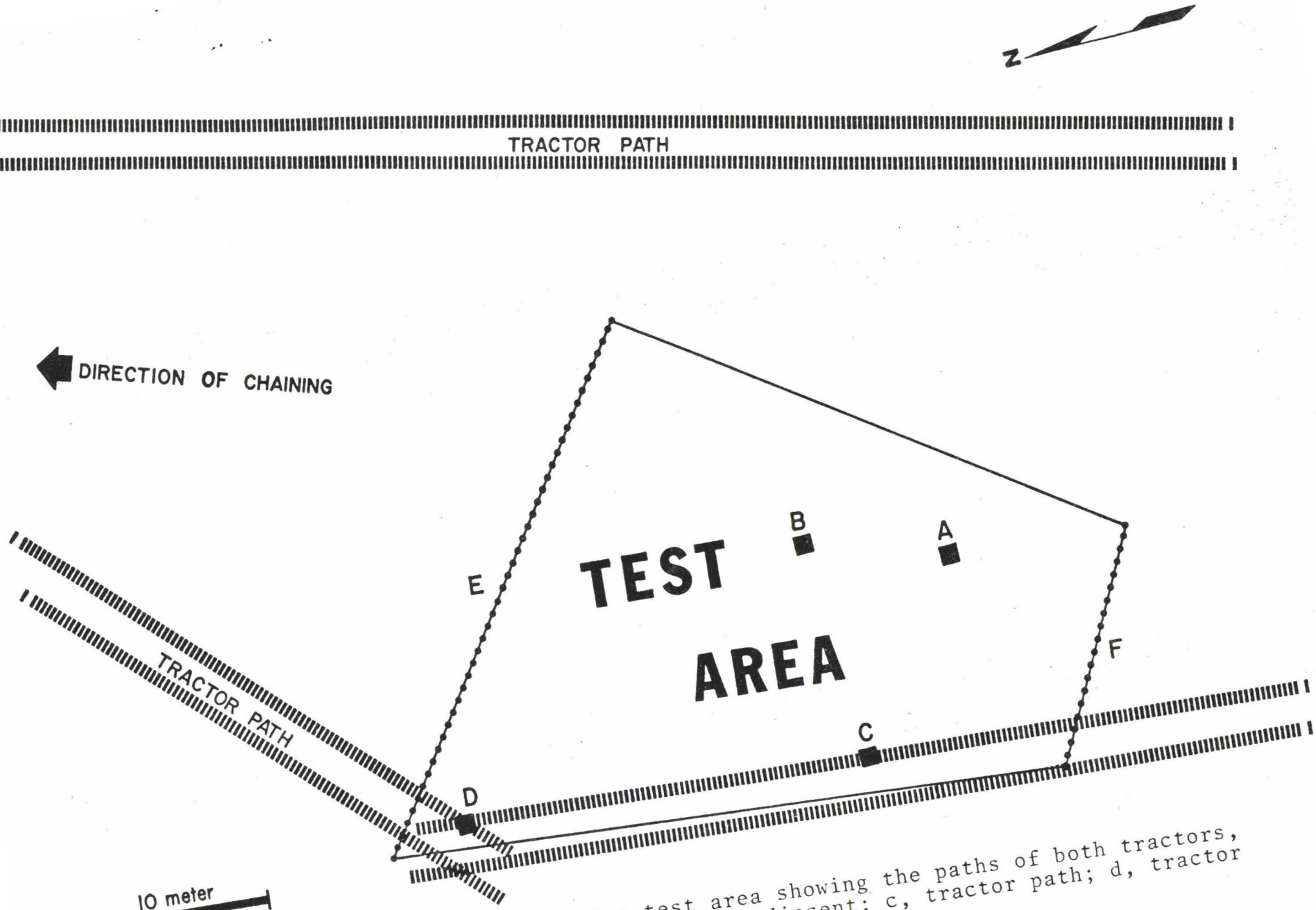

Fig. 13. Plan view of the chaining test area showing the paths of both tractors, four test squares (a, open terrain; b, tree-adjacent; c, tractor path; d, tractor [illegible]), and the two test transects (e and f).